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A BIOLOGICAL EVALUATION OF PESTS ASSOCIATED WITH THE SHEAR AND STACK TECHNIQUE FOR PRECOMMERCIAL THINNING ON THE DOUBLEHEAD RANGER DISTRICT, MODOC NATIONAL FOREST

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ABSTRACT

Several stands on the Doublehead Ranger District that were precommercially thinned with a mechanical shearer were examined in order to provide information to the District on the potential for insect and disease pests adversely affecting the stands. The biologies and possible impacts of annosus root disease and pine engraver as the use of the technique increases are presented. Management alternatives, including no change in current management direction, precommercially thin stands with chain saw, annosus root disease management, slash treatment, and reduce injuries to residual trees, are discussed.

INTRODUCTION

On July 9 and 10, 1985, several stands on the Doublehead Ranger District that were precommercially thinned with a mechanical shearer were examined with Jim Leoni, District Timber Management Officer. The objective was to evaluate the shear and stack technique for present and potential pest problems. Specifically, the District requested a prognosis from Forest Pest Management for the probability of annosus root disease (Fomes annosus) and pine engravers (Ips spp.) adversely affecting management objectives as the technique becomes more common, and information on what alternatives are available to reduce their potential impact.

BACKGROUND

The shear and stack technique involves the use of two opposable, mechanized blades which cut, or shear, standing trees at ground level during thinning. The sheared trees are held, or bunched, by an arm and then stacked in piles. The technique was developed in the South for thinning of southern pine plantations, modified for use in some Oregon forests, and has been used on portions of the Lassen and Modoc National Forests in California since the late 1970's.

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The technique was first tested on the Doublehead District for precommerical thinning in the eastside pine type in 1980. Its use has increased from one acre treated in 1980 to approximately 1500 acres in 1983 and 1984. The use of the technique is expected to increase on the District because it is economical and because it reduces the fuel load on the ground. At an average cost of $120/acre, the cost of the shear and stack technique is about one-half the cost of using chain saws. Also, additional funds to reduce fuel loads on the ground by hand stacking, chipping, crushing, or masticating are not required. The stacking allows for a reduction of the fuels problem created during precommercial thinning.

The equipment currently used on the Doublehead District consists of 22 inch blades mounted on a small DC-4 type caterpillar tractor. Shearing has generally occurred from September through February, but can occur at any season as stands become marked. Leave tree marking by the District is done mainly on the basis of live crown ratio and crown position, with spacing, dwarf mistletoe, and basal area as secondary considerations. Unmarked trees two to 10 inches dbh are sheared. Previously, stems less than two inches dbh were cut with a chain saw, but they are now left in the stand. Trees larger than ten inches dbh are sheared if they will not make a merchantable stem because of sweeping, forking, or other defects.

Stacks contain a few to up to 8 or 10 stems, depending on tree diameter. The stacked trees are left as a source of fuel wood for the general public. However, a commercial market for the stacked fiber for chips and hog fuel is expected to develop in the near future.

OBSERVATIONS

Four areas were examined. Two areas in the vicinity of Tionesta Bench and one in the Sheep Camp area were mechanically sheared in the last 5 years. The fourth area was a stand on Timber Mountain that was thinned with a chain saw in 1968. Overstories were approximately 70-year-old pure ponderosa pine, with sagebrush, rabbitbrush and other vegetation in the understory. Soils were pumice over sandy loam. Site Class is Dunning III. The two stands in the Tionesta Bench area are unburned portions of extensive areas burned in 1978 and 1979 that now contain remnent standing fire-killed trees and escapes, with ponderosa pines planted in the early 1980's. Dwarf mistletoe occurred in some of the fire-escape trees.

Tionesta Bench, Area One

This one acre area was sheared in January, 1980. Some rabbitbrush and a few ponderosa pine seedlings were coming in on the disturbed duff. Although numerous stumps were apparently covered with pumice and duff from the tracks of the equipment in 1980, no covered stumps were found. The pumice may have settled from washing. The five year period between shearing and this examination was too short to expect any evidence of *F. annosus* in the stumps. There were no dead or dying trees near stumps. Most of the sheared stumps were less than 8 inches in diameter. Some of the piles created were still present. There was no evidence of top kill from pine engraver attack in any of the residual trees. Dwarf mistletoe infection on the residuals was scattered and light.

Tionesta Bench, Area Two

This 200 acre area was sheared in January, 1985. The sheared trees were generally a larger diameter than in the first area. Jim Leoni estimated that, depending on the area thinned on the District, there are between 30 and 150 stumps/acre created that are 8 inches or larger in diameter. Numerous trees in this stand were tapered, with 6 1/2 inch dbh trees being 8 inches in diameter at ground level. Few stumps were covered with duff. Numerous stumps were shattered or fractured, either from the shearing or from tracks running over them. The piled slash contained numerous pine engravers (Ips spp.), as evidenced by boring dust, and wood was still fairly moist and green. No evidence of engraver attack in surrounding standing trees was evident.

Sheep Camp

This area contains about 150 acres that were pre-commercially thinned in 1983, and was the first area on the District treated on a large scale with the mechanical shearer. Less pumice is present than in the Tionesta Bench area. No covered stumps were found. A total of 25 stumps from pre-1983 cuttings were examined. Conks of F. annosus were not found in any of the stumps, but two of the 25 had decay typical of the fungus. Two residual trees in the eastern portion of the area were observed with top kill that occurred in 1984, and pine engraver attack was suspected as the cause. Dwarf mistletoe infection was heavy on these trees and was common on other trees in the area.

Timber Mountain

The area examined was thinned with chain saws for a fuelbreak in 1968. Stumps created were flat, cut at or near ground level, and therefore comparable to stumps created by the mechanical shearer. Although decay typical of F. annosus was present, conks were not found in approximately 15 stumps created by the 1968 thinning or in five older stumps.

DISCUSSION

The historical background and etiology of annosus root disease in eastside pine needs to be briefly discussed in order to understand its potential impact in thinned stands. The biology and potential impact of pine engraver in the same type will also be summarized.

Annosus Root Disease

The eastside pine type is one of the forest types most severely impacted by F. annosus. Past surveys conducted by the Lassen National Forest indicate that the number of stumps infected can range from 0 to 50%, but usually runs from 5 to 15% in the pure pine areas of the forest. About 65% of the stumps surveyed on the Fletcher Sale on the Devil's Garden Ranger District on the Modoc National Forest were infected. Normally, a survey and subsequent benefit/cost analysis may be conducted to determine if the application of borax to pine

stumps is economically justified in commercial thinnings. Because of the high levels of annosus root disease indicated above, the Lassen National Forest and the Devil's Garden District made the decision to routinely use borax in all timber sales.

Most annosus root disease infections occur through fungus invasion of freshly cut pine stumps. After the fungus colonizes the pine stump, it moves via root contacts into the root systems of adjacent live trees and kills them by girdling the tree at the root crown. F. annosus in stumps in the eastside pine type has remained infective for 50 years. Observations and individual stand data indicate that the levels of annosus-caused mortality in the eastside pine type is about 10% of the total pine mortality.

Studies in the eastside pine type suggest that several factors limit the initial infection, stump colonization, and spread of annosus root disease. Treatment of freshly cut pine stumps with dry powdered borax prevents the fungus from entering the stump. However, all pine stumps may not have to be treated.

Most infection centers observed are found around stumps 8 inches in diameter and larger. Smaller stumps, even when colonized by the fungus, do not seem to initiate many infection centers. This may be related to temperatures reached in smaller stumps. Invasion of freshly cut stump surfaces by germinating spores is a critical stage of the disease cycle. Spores are produced by conks and disseminated throughout the year, but the spores are dependent on favorable environmental conditions for successful germination and establishment. Spores are inactivated by ambient temperatures of 113°F (45°C) and mycelium in wood is killed after exposure for one hour at 104°F (40°C). In a study in the eastside pine type on the Lassen National Forest, lethal temperatures above 40°C were reached in the top 6 inches of 6 inch diameter and smaller stumps for several days in the average summer. Temperatures did not approach the lethal range in larger diameter classes of stumps.

These studies and observations are the basis for recommending thinning in the summer and, when surveys from past cuttings indicate stump infection rates of 5 to 10%, treating pine stumps 8 inches or larger in diameter with borax at the time of cutting. Presumably temperatures in stumps cut at ground level and partially or completely covered by duff and/or soil in the shear and stack technique would be lower. How much lower and, specifically, if the lower temperatures would be lethal to F. annosus, is not known. Covering of stumps would also increase moisture as well as make them inaccessible for borax treatment.

Pine Engravers

Two species of Ips which commonly kill commercially important pines in California are the California five-spined engraver (Ips paraconfusus) and the pine engraver (Ips pini). Ips paraconfusus is most common west of the crests of the Sierra Nevada and Cascade mountains. It commonly causes localized killing of saplings, poles and the tops of larger trees in the summer when allowed initially to build up in green pine slash during the spring. Ips pini is more common in the eastside pine type. Although it too commonly breeds in fresh pine slash, localized tree killing by this species is not common in

California. Occasionally, however, large populations will develop because of abundant slash. If, coincidentially, standing trees undergo reduced vigor because of a droughty spring, the result can be widespread mortality.

Ips pini will breed in the stacked, fresh, green slash created by the shear and stack technique. If fresh slash is available in the spring or early summer, I. pini may build up in an area and cause locally heavy top killing by mid-summer. Attacks on surrounding live trees will usually be limited to trees which are suppressed, or stressed by dwarf mistletoe, root disease, overstocking, drought, fire or the attack of other insects.

MANAGEMENT ALTERNATIVES

Although evidence of annosus root disease, pine engraver, or other pests in the areas examined was minimal, past experience in the eastside pine type suggests that the potential impact of these pests can affect management objectives. Alternatives to reduce or mitigate their effects are available.

1. No Change in Current Management Direction. Freshly cut stump surfaces are the primary means by which annosus root disease infections occur. As thinnings in the eastside pine type increase, the incidence of Fomes annosus will increase, regardless of the cutting method. The use of a mechanical shearer rather than a chain saw will likely increase the incidence of annosus root disease for the following reasons: 1) the stumps are sheared at ground level; a high stump has a greater chance of heating up sufficiently to kill the fungus, and 2) some of the stumps are covered with duff or soil after shearing because of the action of the tracks; this covering will reduce the amount of solar radiation on the stump surface and probably increase moisture. The lower temperatures and higher moisture are favorable for F. annosus infection.

The actual degree by which annosus root disease will increase in sheared stands and affect management objectives is difficult to predict now because of the lack of information on what temperatures are actually reached in the sheared and covered stumps, how many annosus centers will result from infection of stumps smaller than 8 inches in diameter, and on the level of F. annosus currently present in the stands scheduled for precommerical thinning or in adjacent stands.

The continued creating and stacking of green slash during summer months will increase the risk of pine engraver attacks on adjacent standing trees. Although Ips pini commonly breeds in fresh pine slash, localized tree killing by this species is not common in California. However, large populations will occasionally develop when abundant slash is present. The result can be widespread top-kill and mortality, especially of trees under stress from factors such as heavy dwarf mistletoe infection.

2. Precommercially Thin Stands with Chain Saw. The use of a chain saw instead of a mechanical shearer would avoid the problem of stumps being covered by debris pushed from the tracks, and the stumps would not be at ground level. However, thinning with a chain saw is currently twice the cost of the $120/acre cost of the mechanical shearer. Because the slash created by chain saws would have to be treated in some way to reduce the fuel load on the ground, additional costs would be incurred.

3. Annosus Root Disease Management. Athough the current techniques used with the shear and stack method will likely increase annosus root disease, there are modifications to the method available that will reduce the risk. Once infection centers are established, there is little that can be done to control the disease. Therefore, steps to prevent its establishment in eastside pine stands should be considered. Prevention of annosus root disease can be accomplished by decreasing the risk of stump infection by treatment with borax, timing of operations , creating high stumps, or by removal of stumps and roots.

a. Borax stump treatment: Treatment of freshly cut conifer stumps with borax is about 95% effective in preventing infection. The borax is toxic to the spores of the fungus and prevents germination; it has no effect on existing infections. The chemical should be applied as soon after felling as possible, preferably immediately after, and must cover the entire stump surface for maximum effectivness. Complete coverage with borax of all exposed surfaces on shattered or fractured stumps sometimes created by the shear and stack technique may be difficult. Infection of stumps less than 8 inches in diameter seldom results in the formation of infection centers. Therefore, borax treatment of only stumps 8 inches or larger in diameter is recommended. Where a survey of stumps from past cuttings indicates a stump infection rate of 5 to 10% or higher, consider treating all pine stumps 8 inches or larger in diameter with borax at the time of cutting.

The mechanics of applying the borax could be accomplished by several methods:

1) Trees with stump diameters 8 inches or greater could be cut with a chain saw instead of a shearer, and the borax applied immediately after cutting by the saw operator. This would avoid the problem of covering stumps with soil or duff, but would result in an estimated 20% increase in cost over shearing alone. In addition, thinning with a chain saw would leave fuels on the ground that would need to be treated or stacked, adding additional cost to the procedure.

2) An individual could follow the mechanical shearer and apply the borax to stumps 8 inches or larger in diameter. This would require the hiring of a full time person to apply the chemical and would add about $10/acre to the $120/acre cost of shearing.

3) It may be possible to modify the shearer to have it apply the borax to the stump surface immediately after shearing.

b. Timing of operations: Scheduling of thinning operations during the hot and dry summer months would reduce the risk of infection. Viable conks are scarce and, therefore, few spores are present, at this time of year, and stump temperatures reached may be high enough to kill F. annosus. The timing and coordination of stand marking and actual thinning operations would require some planning, but would not add to the total cost.

c. Create high stumps: Fomes annosus spores have a limited tolerance to high temperature and low moisture in stumps. The sheared stumps cut flush with the ground and/or covered with duff or soil create favorable conditions for infection. If, however, stumps are left 18 to 24 inches high when thinning, internal temperatures and moisture levels have been reported to be such that

the fungus dies before reaching the roots. The roots then become occupied by secondary fungi that prevent F. annosus from becoming established. Stumps are cut flush with the ground by the shearer only to allow for easier movement of vehicles through the stand after the thinning. However, the mechanical shearer is capable of shearing the trees at any height desired. Trees with stump diameters 8 inches or larger could be marked in some way for cutting above ground level, or the operator could make the decision to cut these trees at a higher level as he approached them with the shearer. The relatively few high stumps (30 to 150/acre) that would be created may be tolerable, especially if the formation of annosus infection centers is prevented, and would add little, if any, time or cost to the overall operation.

d. Pull stumps: The removal of host material would eliminate chances of infection. The equipment now being used is quite capable of pulling stumps and roots. The shearer could pull stumps 8 inches or larger from the ground and then shear off the stems. However, the additional time involved would raise the cost of the operation to that of using a chain saw, and the removed material would present a fuels problem.

4. Slash Treatment. The stacked fresh pine slash caused by thinning can be modified in a number of ways to make it unsuitable for pine engraver breeding. One approach to minimizing damage is to schedule the shearing and stacking mostly in the late summer, fall and early winter, when the beetles are not flying or the slash has a high probability of drying out before the beetles can complete their development. Green pine slash created during the spring and early summer should be treated to prevent the buildup of pine engraver populations. Because pine engravers can complete their development in about a month under ideal conditions, treatment should be carried out soon after cutting to be effective. Some methods of slash treatment would include lopping and scattering slash in sunny areas to speed its drying out, crushing or mashing slash with logging equipment to make it unsuitable for pine engraver breeding, or piling and burning the slash within a month of cutting. All of these methods are apparently now unacceptable in the sheared stands on the Doublehead Ranger District because they contribute to the problem of fuels on the ground, add to the treatment cost, or nullify the mechanized stacking portion of the procedure. Creating the stacks of slash in summer, while not completely risk-free from the standpoint of engraver beetle buildup, may be feasible and, if done when the weather is still hot, would coincide with the optimum time to thin for annosus root disease management. Prompt removal of the stacked material for use in commercial markets would eliminate the pine engraver problem.

5. Reduce Injuries to Residual Trees. Significant losses from decay or outright mortality can result from wounds created by mechanized equipment used in stands. The Doublehead District and equipment operators are currently well aware of the potential problems associated with wounded residual trees, and very few injuried residuals were noted. Along with insect and disease considerations, continued care in prevention of wounding during stand entries should be a part of overall stand management.

CONCLUSION

Because the use of the shear and stack technique in the eastside pine type is relatively new, Forest Pest Management is aware that further field observations and studies are needed in order to fully understand the potential for annosus root disease increasing to unacceptable levels in stands thinned with a mechanical shearer. Information on levels of annosus root disease currently present in pine stands on the District, temperatures reached in stumps cut at ground level or covered with debris, and numbers and sizes of centers developing in relation to stump height, stump diameter, and borax treatment needs to be obtained. Some of this information will be gathered by Forest Pest Management through surveys and periodic examinations of stands on the Doublehead Ranger District and on the Lassen National Forest. The Doublehead District should consider examining selected stands thinned with the mechanical shearer on a yearly basis and recording, possibly on stand record cards, dead and dying trees associated with annosus root disease or pine engraver attack. These records will provide some of the information needed by the District to determine what measures need to be taken to reduce pest impact.

Forest Pest Management suggests that the Doublehead Ranger District consider annosus root disease, and other pests, as part of overall stand management. Some of the alternatives available to reduce the potential impact of F. annosus, such as thinning in the summer, cutting high stumps, and boraxing stumps 8 inches or larger in diameter, would add little, if any, to the overall cost and are apparently compatible with other resource objectives. Other, more expensive, alternatives may or may not have to be considered depending on results of further biological information gathered.